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NOTES ON THE KALAMAZOO AND OTHER OLD GLACIAL OUTLETS IN SOUTHERN MICHIGAN.

HAVING occasion recently to cross the state from Melvin near Port Huron to Plainwell, the writer took advantage of the opportunity to make the trip by wheel for the purpose of studying some of the problems of glacial drainage suggested by previous studies. It had been observed earlier that between Plainwell and Battle Creek the Kalamazoo River occupies a wide valley evidently of prior origin. Above Battle Creek the valley is much narrower, while a broader channel bears off to the northeast and furnishes an outlet for the Battle Creek. In eastern Michigan the observations of Taylor, Gilbert, and others have disclosed the existence of several old outlets, though the courses of some of them have not been completely traced. One of these, the Imlay, was traced by the above authors northward past Imlay to North Branch, thence southwestward to Columbiaville. Further, in a letter to the writer, Dr. A. C. Lane, Assistant State Geologist, has pointed out the existence of an old channel between Milford and Hamburg Junction, which is now occupied by the Huron River. Did the Imlay outlet discharge by way of the Kalamazoo or was the latter the outlet for the waters of the Milford channel? While the time at the writer's disposal did not permit a full investigation, the facts obtained are deemed of sufficient interest to warrant their publication as a contribution toward the elucidation of the glacial history of the state.

The Imlay outlet.—This outlet, described and mapped by Taylor,[1] was crossed by the writer near its summit level about ten miles southwest of Brown City. South of this point the swamp which marks the position of the channel is drained toward the northeast by Mill Creek. As far as Yale this creek flows in an old channel which probably received the glacial waters when the ice front had retreated to the position of the Detroit moraine at Melvin and poured them westward into the Imlay outlet. Near Columbiaville there are indications that the waters escaped southward toward Lapeer, following the line of the headwaters of the Flint River, while another smaller trough appears to lead southwest, crossing the line of the C. & G. T. Railway just west of Elba. The latter is well situated to constitute the continuation of the Imlay channel, but the elevation of the bottom of the valley, which is about 800 feet, or thirty feet above that of the Imlay at Columbiaville according to Taylor, would seem to militate against that conclusion. The relations here are somewhat obscure and more detailed investigations are needed to settle the question.

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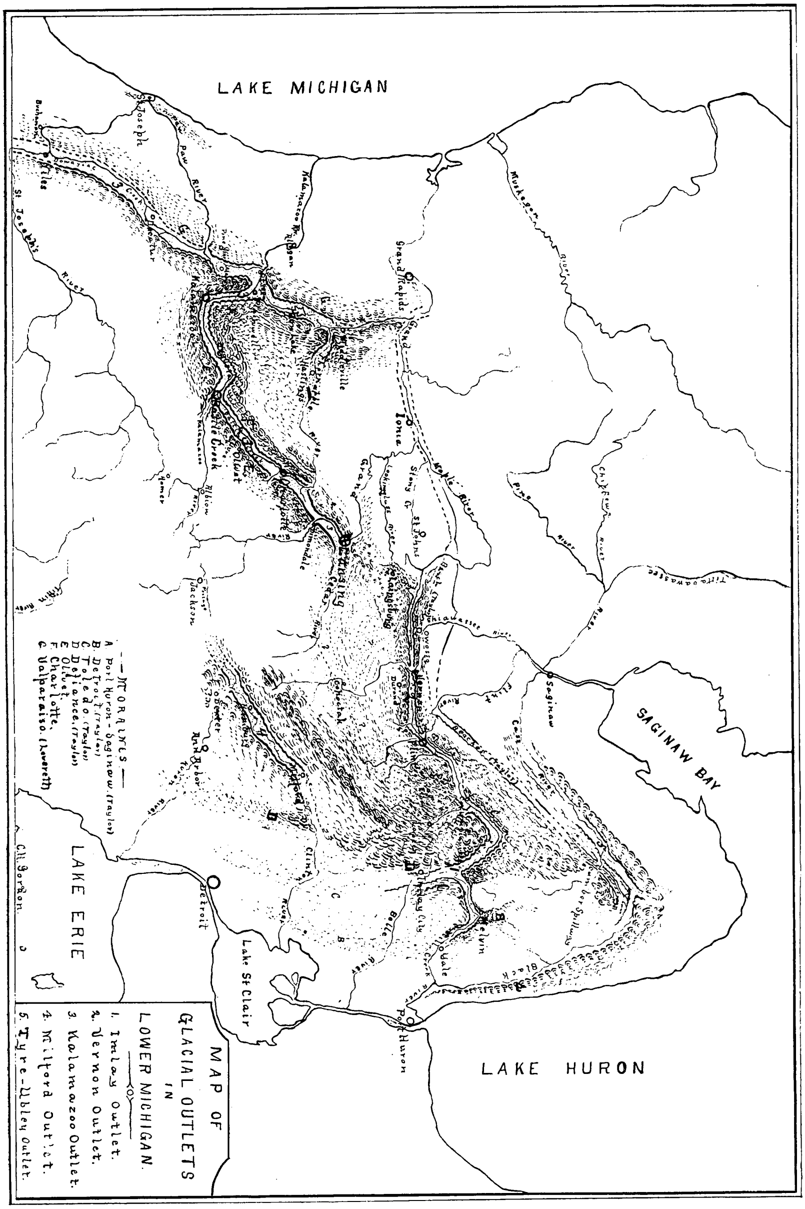
[1] Bull. Geol. Soc. of Amer., Vol. VIII, 1897, pp. 31–58.

The Vernon outlet.— Below Columbiaville the Flint River crosses a moraine which is seemingly the Saginaw, equivalent of the Toledo moraine. At Flint also the river with an abrupt turn breaks through a northward lying parallel ridge which we take to be the equivalent of the Detroit moraine. The valley of the stream where it crosses the first mentioned moraine is much wider than where it crosses the second and has evidently been occupied for a longer time. Before passing through the break in the second moraine it receives a branch from the southwest called Swartz Creek. This stream flows in an old channel which was followed by the writer many miles westward along the south border of the moraine which we may here call the Vernon moraine, from the village of that name which is situated upon its slopes. West of Otterburn the Chicago and Grand Trunk Railway follows the valley bottom as far as Duffield, the stations here being nearly on a level with the valley floor. At Duffield the channel bears directly westward past Vernon. It was followed to a point about nine miles west of this place, or twenty-seven miles in all. The channel has a width of three-fourths of a mile and is covered in part by a black, mucky soil. In places where the drainage is not well established it is wet and swampy. At one point dredging revealed the presence of


LAKE MICHIGAN
LAKE HURON
LAKE ERIE
SAGINAW BAY
Lake St Clair
MAP OF
GLACIAL OUTLETS
IN
LOWER MICHIGAN.
1. Imlay Outlet.
2. Vernon Outlet.
3. Kalamazoo Outlet.
4. Milford Outlet.
5. Tyre-Ubley Outlet.
— MORAINES —
A. Port Huron-Saginaw. (Taylor)
B. Detroit. (Taylor)
C. Toledo. (Taylor)
D. Defiance. (Taylor)
E. Olivet.
F. Charlotte.
G. Valparaiso. (Leverett)
St Joseph
Paw Paw River
Kalamazoo River
Grand Rapids
Grand River
Muskegon River
Ionia
St Johns
Maple River
Pine River
Chippewa River
Tittabawassee River
Shiawassee River
Saginaw
Flint River
Cass River
Kalamazoo
Battle Creek
Albion
Marshall
Olivet
Charlotte
Lansing
Dimondale
Jackson
Laingsburg
Owosso
Durand
Ann Arbor
Milford
Detroit
Imlay City
Melvin
Port Huron
Black River
Clinton River
Belle River
Niles
St Joseph River
Ch. H. Gordon.

gravel beneath the muck. Outside the muck area which comprises a belt of varying width extending along the middle of the valley the floor is covered with sandy gravel. Bowlders are not abundant though one field was seen to be thickly strewn with them. Toward the east this portion of the channel is drained by Swartz Creek, which enters it from the south about a mile west of Swartz Creek station, and toward the west it is drained by a branch of Maple River. The middle portion is intersected by the Shiawassee River and one of its branches. The Shiawassee enters the valley about three miles west of Vernon and follows it to the latter place, where it breaks through the moraine northward. The further course of the channel westward is not known, but it probably either continues past St. Johns down Stony Creek or follows the Maple by way of Duplain to the old Grand River outlet. If the Vernon moraine is the equivalent of the Detroit moraine as we infer, then the Vernon outlet must have been active at the time the Mill Creek channel was open at Melvin, the waters from which found their way westward through the bend of the Imlay outlet, though at a later stage the latter may have been abandoned for an outlet farther north, possibly by way of Otter Lake. Within the limits described the known elevations of the channel floor as shown by the railroad levels at the stations named, which are generally within a few feet of the bottom level, are as follows: Otterburn 771, Swartz Creek 779, Crapo 774, Duffield 780, Vernon 780.

The Kalamazoo outlet.—This is one of the most important of the glacial outlets observed within the state. Previous observations had shown the existence of a channel between Battle Creek and Plainwell, but its extension east and west from these points was unknown. Our recent observations have shown that this channel extends northeastward from Battle Creek as far as Lansing, at which point it turns eastward, but beyond which it has not been traced. From this place to Plainwell it follows the outer border of a moraine (*F*), here named the Charlotte moraine from the city of that name which is situated upon it

Between Plainwell and Otsego it turns abruptly southward along the outer border of the Valparaiso moraine (*G*), past Decatur and Niles to South Bend, and thence evidently, according to Leverett's observations, the waters reached the Illinois River by way of the Kankakee. On the south and east side the waters were confined by the Olivet moraine (*E*). Between Lansing and Plainwell the channel has an average width of about a mile, but is somewhat wider in its lower portion. At the bend near Kalamazoo it has a width of two and a half miles and at Plainwell it is much wider. At Plainwell a branch comes in from the northeast by way of Gun Lake that is in direct connection with the upper part of the valley of the Thornapple River which is here wide and was evidently active as an outlet at a later stage than the Kalamazoo. The connection between the Thornapple and Gun Lake divisions is through a series of small lakes and marshes in Yankee Springs township.

Between Dimondale and Charlotte the Kalamazoo channel is marked by a long narrow marsh some portions of which have been brought under cultivation. Similar marshy tracts occur also between Charlotte and Battle Creek, at Kalamazoo and south of Otsego. At Kalamazoo the mucky soil has been utilized for growing the celery for which that city has become noted. Outside the mucky areas the channel floor is covered with sand and gravel. In some places sand predominates and often occurs in low mounds and ridges. Gravel, however, mixed with more or less sand is the principal constituent of the valley filling. Gravel beds occur along the sides of the valley as remnants of a terrace, the top of which is about fifteen feet above the general plain level. Cultivated fields generally show an abundance of cobble stones strewn over the surface and in some places bowlder patches occur. At Charlotte gravels constitute the low divide between the headwaters of Battle Creek and Thornapple River occupied by the Grand Rapids branch of the Michigan Central Railway. At Plainwell a bluff of gravel twenty feet high extends along the north bank of the river which here flows over a stony bottom.

At Dimondale the Grand River enters the valley from the southeast and follows it to Lansing, a distance of nine miles, where, after receiving Cedar River, it passes through the Charlotte moraine northwestward. The marshy tract between Dimondale and Charlotte is drained westward through the Thornapple, while below Charlotte the drainage is effected by Battle Creek. At Otsego the Kalamazoo leaves the old channel and passes out westward through a narrow gorge in the Valparaiso moraine.

The elevations of railroad stations which appear to be situated about on the level of the valley floor are as follows: Lansing (C. & G. T. R. R.) 836, Battle Creek (C. & G. T. R. R.) 823, (M. C. R. R.) 818, Bedford (M. C. R. R.) 807, Augusta (M. C. R. R.) 789, Galesburg (M. C. R. R.) 788, Comstock (M. C. R. R.) 778, Kalamazoo (M. C. R. R.) 770, (G. R. & I. R. R.) 778, Cooper (G. R. & I. R. R.) 774, Travis (G. R. & I. R. R.) 746, Plainwell (G. R. & I. R. R.) 741, Alamo (M. C. R. R.) 764, Williams (M. C. R. R.) 759. If the Kalamazoo channel received the waters of the Imlay outlet during the earlier stage of the activity of the latter, as we are inclined to believe, further investigations will probably show a connection to exist by way of Cohoctah and Lapeer or west of the latter place. However, more detailed work will doubtless bring to light other lines of drainage and until such work is done no reliable prediction can be made. During the time of greatest activity of the Kalamazoo outlet when the edge of the Saginaw lobe occupied the position of the Charlotte moraine and that of the Michigan lobe was at the position of the Valparaiso moraine, the waters from the two opposing ice fronts north of Plainwell evidently came down by way of the Gun Lake branch. Later when the Saginaw lobe had retreated to the north side of the Thornapple River, the principal drainage must have been by way of the Thornapple and Gun Lake channel.

The Milford channel.—The only part of this channel as yet known is the wide valley occupied by the Huron River between Milford and Hamburg Junction. It has been suspected that this channel connected with the Kalamazoo outlet, but from what has preceded it is evident that the westward extension of the Milford channel must be sought farther south. From the behavior of the rivers and the general character of the drainage it is suspected that the course of this channel lies westward along Portage Creek, a few miles north of Jackson, then southwestward by way of Homer, and thence down the St. Joseph River, joining the Kalamazoo at South Bend.

Reversal of Drainage.—The limited amount of study thus far given to the region has shown the existence of many interesting examples of stream piracy and reversed drainage. The writer has pointed out one of these in the case of Black River near Port Huron.[1] Several others can be readily pointed out on the accompanying map. It is evident that the region of southern Michigan offers excellent opportunity for physiographic study, and the legislature of the state could not perform a better service than to make a liberal appropriation to the geological survey for the purpose of putting this material in shape for the use of the public schools.

C. H. GORDON.

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[1] JOUR. GEOL., Vol. V, 1897, p. 315.